

AutoAnalyzer 500

Method no. A-043-19 Rev.2



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Ammonia in Water and Seawater (MT519)

1 SCOPE

This method covers the determination of Ammonia-N in drinking water and seawater. Additional sample pre-treatment might be required.

2 CALIBRATION RANGE

Low Range:

Water: 0.4 - 8 µmol/L (5.6 - 112 µg/L as N)

Seawater: 0.4 - 8 µmol/L (5.6 - 112 µg/L as N)

High Range:

Water: 4.3 - 86 µmol/L (60.2 - 1204 µg/L as N)

Seawater: 4 - 80 µmol/L (56 - 1120 µg/L as N)

3 TYPICAL PERFORMANCE DATA

	Water		Seawater	
	Low range	High range	Low range	High range
Sampling Rate	60 samples/h, 4:1		60 samples/h, 4:1	
Highest Calibrant	8 µmol/L	86 µmol/L	8 µmol/L	80 µmol/L
Blank variation (SD of 10 sequential blanks)	0.006 µmol/L	0.01 µmol/L	0.008 µmol/L	0.006 µmol/L
Detection limit (EPA procedure 40 CFR Part 136, App. B)	0.045 µmol/L	0.03 µmol/L	0.024 µmol/L	0.03 µmol/L

These performance statistics were generated using genuine SEAL Analytical parts and consumables. Performance may vary depending on system components and the number of channels selected.

Performance values are pooled from independent runs. Refer to section 16 for details.

4 METHOD PRINCIPLE

Based on the Berthelot reaction, ammonia is reacting with salicylate and chlorine from dichloroisocyanuric acid to form indophenol blue in an alkaline environment at 37°C. Sodium nitroprusside is used as a catalyst in the reaction. The formed color is measured at 660 nm.

5 REFERENCES

1. Standard methods for the examination of water and waste water, 23rd edition, 2017

6 HARDWARE REQUIREMENTS

Chemistry Hardware: 2.0 mm glass, 5 mL heating bath
Detector: LED photometer at 660 nm, 10 mm flowcell
Pump tubes: 6 + 2 air + sampler wash

7 LIST OF REQUIRED CHEMICALS

All chemicals must be of analytical grade quality (ACS grade, pro analysi, ...). DI water refers to high grade quality distilled or deionized water, free from organic contamination (e.g. ISO 3696 Grade 1 or ASTM standard D 1193 Type I/II)

Persons using this method should be familiar with normal laboratory practice. This method does not purport to address all safety risks, if any, associated with its use. It is the responsibility of the user to establish safety and health practices and to ensure compliance with local regulatory conditions.

Compound	CAS No.	Safety classification
Ammonium sulfate	7783-20-2	--
Ethylenediaminetetraacetic acid tetrasodium salt dihydrate	10378-23-1	GHS07
Hydrochloric acid, 36.5-38%	7647-01-1	GHS05, GHS07
Sodium hydroxide	1310-73-2	GHS05
Sodium nitroprusside	13755-38-9	GHS06
Sodium salicylate	54-21-7	GHS07
Dichloroisocyanuric acid, sodium salt	51580-86-0	GHS03, GHS07, GHS09
tri-Sodium citrate dihydrate	6132-04-3	--
Brij-35, 22-30% solution	9002-92-0	--

GHS01: Danger - Explosive; GHS02: Danger - Flammable; GHS03: Danger - Oxidizing; GHS04: Warning - Compressed gas; GHS05: Warning/Danger - Corrosive; GHS06: Danger - Toxic; GHS07: Irritant; GHS08: Danger - Health hazard; GHS09: Warning/Danger - Environmentally Damaging

8 REAGENT PREPARATION

To reach the stated performance values, standard, reagents and sampler wash must be free of solids and dissolved air.

For best performance vacuum filter all reagents through a 0.45 µm filter or glass filter paper. If necessary, vacuum filter all DI water used in the preparation of standards and for the sampler wash or degas the water in another way.

8.1 SAMPLER WASH SOLUTION

Raw Material	Amount	Reagent Label
Sodium chloride	35 g	N/A
DI water	to 1000 mL	
Storage: plastic container at room temperature Stability: one week		


Dissolve 35 g of sodium chloride in about 800 mL of DI water. Dilute to 1000 mL with DI water and mix thoroughly.

8.2 SYSTEM WASH SOLUTION

Raw Material	Amount	Reagent Label
DI water	1000 mL	N/A
Brij 35, 22-30% solution	2 mL	
Storage: glass or plastic bottle at room temperature Stability: infinite, replace if turbid or cloudy		


Add 2 mL of Brij-35 solution to 1000 mL of DI water and mix thoroughly.

8.3 SODIUM HYDORXIDE 1 mol/L

Raw material	Amount	Reagent Label
Sodium hydroxide	40 g	<div></div> <div>Warning</div>
DI water	to 1000 mL	
Storage: Plastic bottle at room temperature Stability: Infinite, replace if turbid or cloudy		

Dissolve 40 g of sodium hydroxide in about 700 mL of DI water. Dilute to 1000 mL with DI water and mix thoroughly.

8.4 HYDROCHLORIC ACID 1 mol/L

Raw material	Amount	Reagent Label
Hydrochloric acid, 36.5 – 38%	85 mL	 Warning
DI water	to 1000 mL	
Storage: Plastic bottle at room temperature Stability: Infinite, replace if turbid or cloudy		

Add 85 mL of hydrochloric acid to about 700 mL of DI water. Cool to room temperature. Dilute to 1000 mL with DI water and mix thoroughly.

8.5 BUFFER

Raw Material	Amount	Reagent Label
Ethylenediaminetetraacetic acid tetrasodium salt dihydrate	30 g	N/A
tri-Sodium citrate dihydrate	120 g	
Sodium nitroprusside	0.5 g	
DI water	to 1000 mL	
Brij 35, 22-30% solution	3 mL	
Storage: glass or plastic bottle at 4°C Stability: one week		



Dissolve 30 g of Ethylenediaminetetraacetic acid tetrasodium salt, 120 g of *tri*-sodium citrate and 0.5 g sodium nitroprusside in about 600 mL of DI water. Dilute to 1000 mL with DI water, mix thoroughly and add 3 mL of Brij-35 solution.

8.6 SALICYLATE REAGENT

Raw Material	Amount	Reagent Label
Sodium salicylate	300 g	N/A
DI water	to 1000 mL	
Storage: amber glass or plastic bottle at room temperature Stability: one week		

Dissolve 300 g of sodium salicylate in about 600 mL of DI water. Dilute to 1000 mL with DI water and mix thoroughly.

8.7 DICHLOROISOCYANURIC ACID (DCI)

Raw Material	Amount	Reagent Label
Sodium hydroxide	5 g	<div></div> <div>Danger</div>
Dichloroisocyanuric acid, sodium salt	0.2 g	
DI water	to 100 mL	
Storage: glass or plastic bottle at 4°C Stability: one week		

Dissolve 5 g of sodium hydroxide and 0.2 g of dichloroisocyanuric acid in about 60 mL of DI water. Dilute to 100 mL with DI water and mix thoroughly.

9 STANDARDS

These formulas assume that samples are preserved with the described preserving solution (see section 10). If other preservation methods are used, the sample and standard matrix and the sampler wash solution should be similar.

9.1 STOCK STANDARD A – 4 mmol/L

Raw Material	Amount	Reagent Label
Ammonium sulfate	0.5286 g	N/A
DI water	to 1000 mL	
Storage: glass or plastic bottle at 4°C Stability: one year		

Dissolve 0.5286 g of ammonium sulfate in about 600 mL of DI water. Dilute to 1000 mL with DI water and mix thoroughly.

9.2 STOCK STANDARD B – 400 µmol/L

Raw Material	Amount	Reagent Label
Stock standard A – 1000 mg/L NH4-N	10 mL	N/A
DI water	to 100 mL	
Storage: glass or plastic bottle at 4°C Stability: one year		

Pipette 10 mL of Stock standard A into a 100 mL volumetric flask. Dilute to volume with DI water and mix thoroughly.

9.3 WORKING STANDARDS

Prepare working standards fresh every day before use. For example:

mL of Stock A	µmol/L	mL of Stock B	µmol/L
2.0	80	2.0	8
1.5	60	1.5	6
1.0	40	1.0	4
0.5	20	0.5	2
0.1	4	0.1	0.4

Pipette each aliquot of stock standard A or stock standard B into a 100 mL volumetric flask. Dilute to volume with DI water or synthetic seawater and mix thoroughly.

10 SAMPLE PRESERVATION AND STORAGE

Samples containing particles > 0.1 mm must be filtered. Strongly acidic or alkaline samples must be approximately neutralized before analysis.

11 INTERFERENCES

Low-molecular amines react similarly to ammonia and will consequently lead to erroneously high results. Interferences may occur if the reaction mixture after addition of all reagent solutions does not reach a pH of at least 12.6 (see *operating note 1*). This mainly happens with strong acidic and buffered samples.

Metal ions in high concentrations, which precipitate as hydroxides, may cause poor reproducibility.

12 START-UP PROCEDURE

1. Switch on all modules
2. Start pumping:
 - DI water through the sampler wash, DI water and unused sample lines
 - System wash solution through the reagent lines
3. Wait for a stable bubble pattern
4. Switch the reagent lines from wash solution to their corresponding reagent
5. Wait for the baseline to stabilize again.

13 SHUTDOWN PROCEDURE

1. Pump for at 20 minutes:
 - DI water through the sampler wash, DI water and unused sample lines
 - System wash solution through the reagent lines
2. Release the pump platen
3. Switch of all modules.

14 SYSTEM CLEANING PROCEDURE

DAILY:

Follow the shutdown procedure.

WEEKLY:

Pump 1N HCl for 10 minutes through all reagent lines and DI water through the sample line. Flush out the HCl by pumping system wash solution through the reagent lines for 10 minutes.

15 OPERATING NOTES

1. Recommended procedures for best performance when analyzing low concentrations

- Pure water may be double distilled (DD) water or deionized (DI) water. In the case of DD water, the analyst must be careful to avoid contamination with silicic acid from dissolution of glass.
- For accurate low-level work, all glassware used for making reagents should be rinsed with 10% hydrochloric acid followed by thorough rinsing with DI water two or more times. Store flasks "shaken dry" and capped. Regular cleaning of storage containers reduces variances in analytical results. Do not wash the glassware in a washer or with any kind of detergent.
- Sample cups must be perfectly clean. For low-level work, fill sample cups with 10% hydrochloric acid and leave standing for at least 15 minutes. Then rinse the sample cups twice with DI water followed by two rinses with sample or standard solution.
- Sample storage or transport containers may be made of any of several plastics. High density polyethylene or polypropylene bottles are recommended. Glass containers of any kind are not acceptable. Any glass contaminates the samples with silicic acid. Sample containers must be rinsed at least twice with sample before filling.
- Skin contact must be avoided with anything which will touch the reagents and samples. Ammonia contamination of the air must be avoided (e.g. by smoking, farmyard, industrial smoke or vapor, other reagents).
- The laboratory temperature should be reasonably stable, with no strong air currents around analyzer. Run the system with the manifold cover in place.
- All chemicals should be of very high purity. Final working standards are best prepared using natural artificial seawater of low nutrient content.
- The prepared reagents should be degassed by vacuum membrane filtration for best performance. Filters with a pore size of 0.5 µm or less should be used. The reagents, pure water and standards should be protected from atmospheric contamination.
- Samples should be measured as soon as possible after sampling.
- Rinse the manifold according to the given procedures. Rinse the wash receptacle each day by pumping baseline reagents for 15 minutes before starting a run. Clean the wash receptacle once a month with hypochlorite solution.
- The volume between the air valve and the injection fitting should be minimal, using 0.015" polyethylene tubing cut as short as possible. The joints between glass parts must be perfect without gaps.
- A regular bubble pattern is necessary for low noise. If the bubble pattern is irregular, check that all plastic tubing is correctly wetted (bubble shape round at front and back). After replacing the pump tubes or parts of the manifold, pump 1M NaOH through all tubes for 15 minutes.

2. For optimum results the pH of the final reaction solution must be within certain limits. Collect the solution from the flowcell waste line to check the pH.

Final pH (with salicylate reagents) pH 12.8 - 13.1

If the final pH is too high, reduce the sodium hydroxide concentration. If the pH is too low, increase the sodium hydroxide concentration.

3. **WARNING:** Sodium salicylate precipitates in acid solution. Therefore, if an acid-based chemistry (e.g. phosphate) will be run on this multitest channel next make sure that the salicylate is washed out completely before pumping any of the reagents into the system. During the day it may occur that a slight precipitation occurs in the 5-turn coil after the DIC addition. This does not affect performance. If it occurs, during the shutdown procedure clean the system with 1N HCl. Be sure that the salicylate has been washed out first, otherwise there will be a precipitate of salicylic acid, which will block the tubing.
4. Ammonia is a common contaminant in the atmosphere and the general environment. Take extra precautions to avoid contamination of the reagents. Do not touch any surfaces which will be in contact with reagents or samples. Check the reagent absorbance each time fresh reagents are made. If it is too high, the detection limit will be increased.
5. If dual-range operation is not needed, remove sample line B and tie off the T-piece. If dual-range operation is needed, pump DI water through the sample line which is not connected to the sample probe.
6. The concentration of free chlorine in the reaction mixture is critical to correct sensitivity and linearity. As neither the source chemical nor the solution is stable, the concentration should be adjusted by experiment if the method becomes non-linear or the sensitivity is low. Baseline noise and drift will be optimized by using the lowest concentration which gives acceptable results.
7. If DIC is not readily available, sodium hypochlorite can be used as an alternative chlorine source. In most cases, diluting the stock solution 10:1 with water will produce an acceptable working reagent whose concentration should then be optimized by experiment. Reagent optimization should be repeated every few months or when a new bottle of chemical is opened. If using NaOCl, which is alkaline, check the pH after optimizing the concentration of the NaOCl (*see operating note 2*).
8. Even flow and regular air/liquid distribution in the transmission tube from the debubbler after the first mixing coil to the pump is critical to correct method performance. Check for correct flow and that the tubing is wetted (the trailing edge of the bubbles must be rounded, not straight). If necessary, especially for new tubing, increase the concentration of surfactant to achieve correct wetting.

16 PERFORMANCE VALIDATION

16.1 TEST CONDITIONS

Sampler type	XY-2
Sample probe	HiTech, 0.75 mm
Sample tubing and length	PE15, 90 cm
Total sample flow rate (incl. by-pass and other channels)	Sample high: 1.2 mL/min
Wash pot type	Fixed
Wavelength	660 nm
Reference energy	
Sample:ref ratio	
Light power	98%
Room temperature	22 – 25°C

16.2 PERFORMANCE DATA – OVERVIEW

	Water		Seawater	
	Low range	High range	Low range	High range
Highest Calibrant	8 µmol/L	86 µmol/L	8 µmol/L	80 µmol/L
Sensitivity (in specified flowcell)	0.06 – 0.08 AU	0.70 – 0.80 AU	0.07 – 0.09 AU	0.72 – 0.84 AU
Correlation Coefficient (linear, six points)	0.999	0.999	0.999	0.999
Reagent absorbance	0.02 AU		0.02 AU	
Coefficient of Variation	0.015 µmol/L; 0.4%	0.07 µmol/L; 0.2%	0.014 µmol/L; 0.3%	0.12 µmol/L; 0.3%
Pooled SD	0.017 µmol/L	0.08 µmol/L	0.016 µmol/L	0.11 µmol/L
Blank variation (SD of 10 sequential blanks)	0.006 µmol/L	0.01 µmol/L	0.008 µmol/L	0.006 µmol/L
Detection limit (EPA, spikes)	0.020 µmol/L	0.03 µmol/L	0.024 µmol/L	0.03 µmol/L
Detection limit (EPA, blanks)	0.045 µmol/L	0.03 µmol/L	0.023 µmol/L	0.02 µmol/L

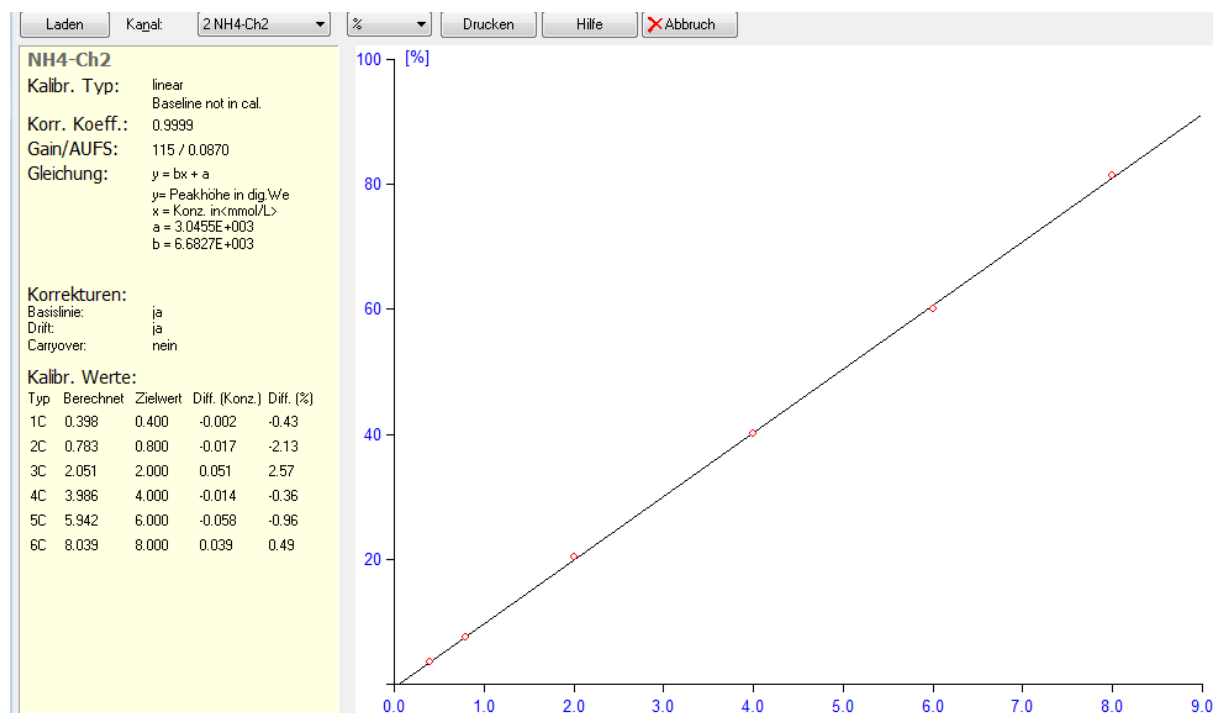
These performance statistics were generated using genuine SEAL Analytical parts and consumables.

Performance may vary depending on system components and the number of channels selected.

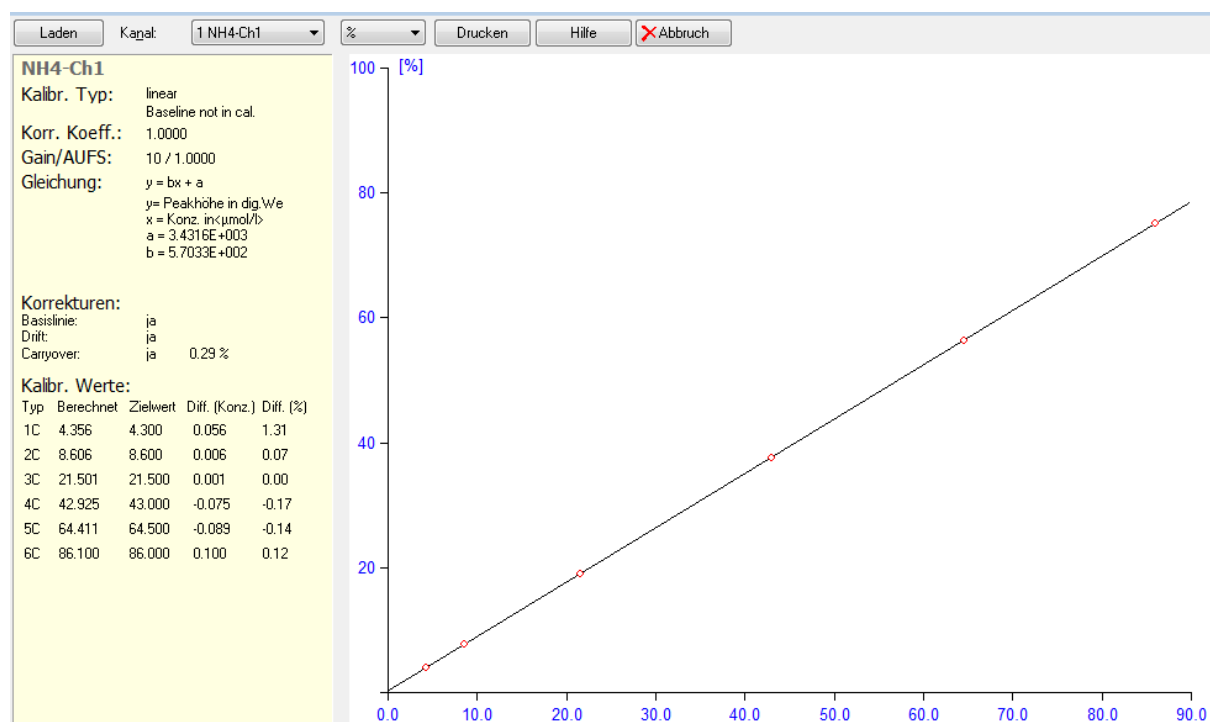
Performance values are pooled from independent runs. The **bold** values are reported on the first page of this method document.

16.3 CALIBRATION DATA

16.3.1 WATER

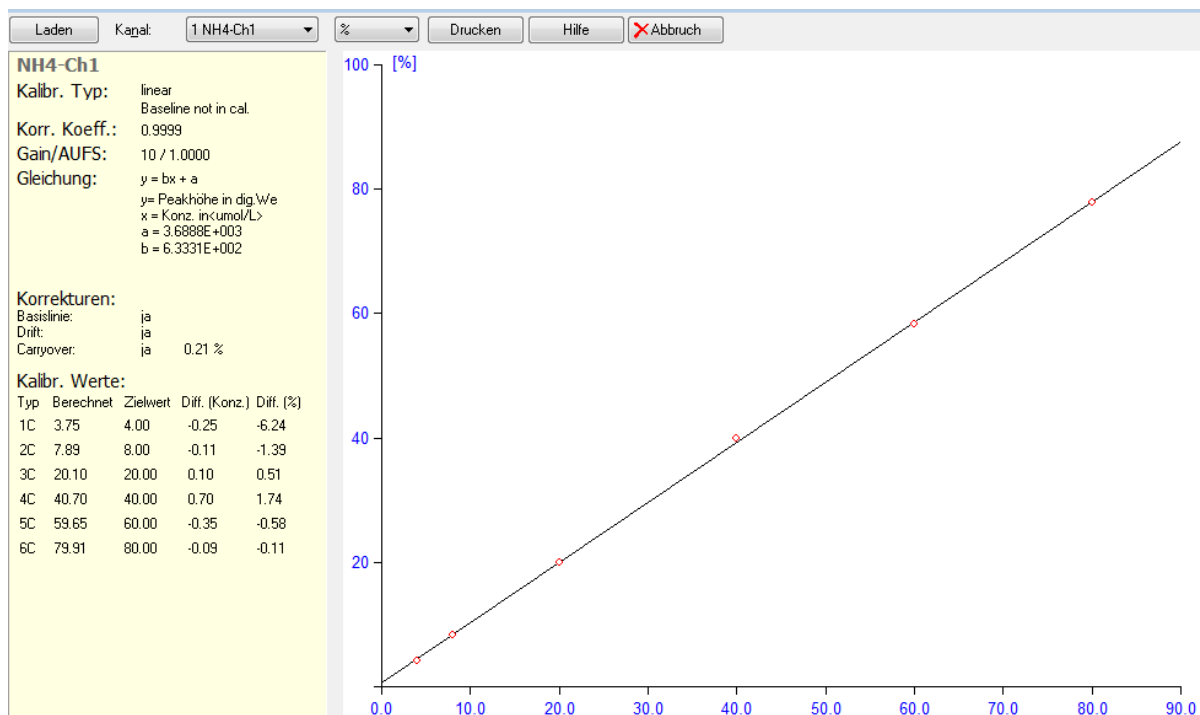
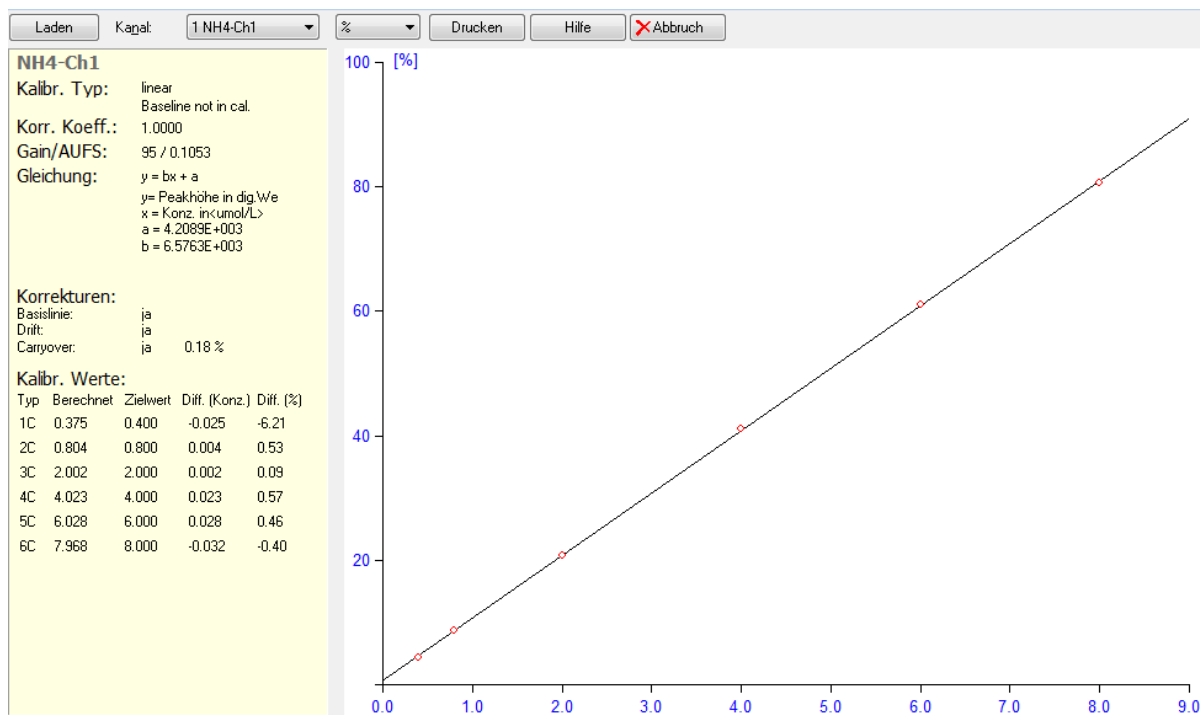


Low calibration range: 0.4 to 8 $\mu\text{mol/L}$. Absorbance of top standard: 0.07 AU



High calibration range: 4 $\mu\text{mol/L}$ to 86 $\mu\text{mol/L}$ as N. Absorbance of top standard: 0.75 AU

16.3.2 SEAWATER



16.4 REPRODUCIBILITY – SAME CONCENTRATION

The reproducibility is checked by measuring 20 replicates of a 50% calibration range standard. Three runs are performed on three different days. Baseline and sensitivity drift correction are applied. The coefficient of variation is calculated by dividing the standard deviation of the replicates by the mean and then multiplying with 100.

16.4.1 WATER

Run no.	Low Range			High Range		
	1	2	3	1	2	3
	$\mu\text{mol/L as N}$			$\mu\text{mol/L as N}$		
<i>Nominal</i>	4.000			43.00		
1	3.991	4.000	4.018	42.97	42.99	43.21
2	3.993	4.02	3.998	42.96	43.03	43.26
3	4.024	3.980	4.011	43.04	43.00	43.26
4	4.001	3.967	4.020	43.07	43.03	43.20
5	4.016	3.988	4.017	43.11	43.10	43.20
6	4.006	4.018	4.032	43.06	43.12	43.23
7	3.987	4.018	4.009	42.99	43.08	43.24
8	4.020	3.991	3.999	42.96	43.00	43.20
9	3.993	3.985	4.011	43.14	43.04	43.19
10	3.983	4.000	4.027	43.08	43.10	43.21
11	4.004	4.028	4.030	43.07	43.08	43.20
12	3.997	3.996	3.989	42.95	43.09	43.17
13	4.026	4.008	3.995	42.97	43.04	43.16
14	3.996	4.012	4.003	43.01	43.03	43.08
15	3.997	4.014	4.004	42.90	43.03	43.05
16	4.006	4.033	3.983	43.01	42.99	43.10
17	3.998	4.011	3.990	42.85	42.93	43.04
18	4.010	4.000	3.981	42.96	43.01	42.97
19	3.992	3.994	3.980	42.96	43.02	42.95
20	4.005	4.015	3.989	43.00	43.02	43.04
Mean	4.002	4.004	4.004	43.00	43.04	43.15
Std. deviation	0.012	0.017	0.016	0.07	0.04	0.09
Coefficient of variation	0.3%	0.4%	0.4%	0.2%	0.1%	0.2%

16.4.2 SEAWATER

Run no.	Low Range			High Range		
	1	2	3	1	2	3
	$\mu\text{mol/L as N}$			$\mu\text{mol/L as N}$		
<i>Nominal</i>	4.000			40.00		
1	3.987	3.984	4.047	40.92	40.72	40.59
2	3.984	3.987	4.049	40.83	40.63	40.50
3	3.978	4.000	4.045	40.8	40.62	40.49
4	3.982	3.995	4.037	40.82	40.70	40.55
5	3.978	3.998	4.024	40.78	40.72	40.60
6	3.977	3.984	4.033	40.76	40.71	40.58
7	3.978	3.981	4.039	40.72	40.60	40.49
8	3.965	3.984	4.024	40.73	40.58	40.46
9	3.974	3.984	3.997	40.74	40.68	40.46
10	3.972	3.994	3.995	40.69	40.66	40.55
11	3.973	3.979	4.011	40.64	40.57	40.42
12	3.965	3.973	4.002	40.67	40.44	40.27
13	3.958	3.984	3.986	40.65	40.46	40.32
14	3.964	3.982	3.989	40.58	40.54	40.37
15	3.960	3.988	3.998	40.64	40.53	40.32
16	3.962	3.980	4.004	40.58	40.45	40.16
17	3.964	3.987	3.992	40.59	40.33	40.23
18	3.962	3.989	3.989	40.55	40.36	40.22
19	3.959	3.971	4.010	40.5	40.45	40.23
20	3.964	3.992	3.998	40.59	40.45	40.28
Mean	3.970	3.986	4.013	40.69	40.56	40.40
Std. deviation	0.009	0.008	0.022	0.11	0.12	0.14
Coefficient of variation	0.2%	0.2%	0.5%	0.3%	0.3%	0.4%

16.5 REPRODUCIBILITY – VARYING CONCENTRATION

Reproducibility is checked by running ten replicates of five different standards in pseudo-random order. Three runs are performed on three different days. Baseline, sensitivity drift and carryover correction are applied.

16.5.1 WATER

	Low Range				High Range			
		1	2	3		1	2	3
Group	Nominal concentration $\mu\text{mol/L}$ as N	Standard deviation in $\mu\text{mol/L}$ as N			Nominal concentration $\mu\text{mol/L}$ as N	Standard deviation in $\mu\text{mol/L}$ as N		
1	8	0.020	0.018	0.018	86	0.10	0.06	0.06
2	6	0.021	0.012	0.020	64.5	0.08	0.10	0.11
3	4	0.016	0.008	0.014	43	0.14	0.12	0.06
4	2	0.013	0.011	0.016	21.5	0.08	0.06	0.05
5	0	0.032	0.016	0.018	0	0.03	0.04	0.04
Pooled SD		0.021	0.013	0.017	Pooled SD	0.09	0.08	0.07

16.5.2 SEAWATER

	Low Range				High Range			
		1	2	3		1	2	3
Group	Nominal concentration $\mu\text{mol/L}$ as N	Standard deviation in $\mu\text{mol/L}$ as N			Nominal concentration $\mu\text{mol/L}$ as N	Standard deviation in $\mu\text{mol/L}$ as N		
1	8	0.015	0.017	0.045	80	0.13	0.17	0.24
2	6	0.011	0.009	0.018	60	0.09	0.12	0.14
3	4	0.008	0.011	0.026	40	0.05	0.09	0.10
4	2	0.015	0.009	0.006	20	0.03	0.04	0.06
5	0	0.008	0.011	0.012	blank	0.03	0.03	0.08
Pooled SD		0.012	0.012	0.025	Pooled SD	0.08	0.10	0.14

16.6 DETECTION LIMIT DATA (EPA SPIKE METHOD)

The detection limit MDL_s is determined from 10 replicates of spikes. Three runs are performed on three different days. Baseline and sensitivity drift are applied. The detection limit is calculated by multiplying the standard deviation of the replicates by the student factor for 10 replicates ($T = 2.821$).

16.6.1 WATER

Run no.	Low Range			High Range		
	1	2	3	1	2	3
	$\mu\text{mol/L as N}$			$\mu\text{mol/L as N}$		
<i>Nominal</i>	0.160			1.60		
1	0.139	0.122	0.215	1.62	1.43	1.67
2	0.131	0.124	0.218	1.63	1.45	1.67
3	0.144	0.122	0.225	1.62	1.44	1.67
4	0.15	0.133	0.224	1.63	1.44	1.67
5	0.144	0.132	0.228	1.61	1.43	1.67
6	0.139	0.126	0.238	1.62	1.44	1.67
7	0.135	0.119	0.235	1.62	1.44	1.67
8	0.134	0.123	0.235	1.61	1.44	1.67
9	0.153	0.123	0.236	1.63	1.44	1.67
10	0.151	0.123	0.226	1.60	1.42	1.68
Mean	0.142	0.125	0.228	1.62	1.44	1.67
Std. deviation	0.008	0.005	0.008	0.01	0.01	0.01
Detection Limit	0.023	0.014	0.023	0.03	0.03	0.03

16.6.2 SEAWATER

Run no.	Low Range			High Range		
	1	2	3	1	2	3
	$\mu\text{mol/L as N}$			$\mu\text{mol/L as N}$		
Nominal	0.160			1.60		
1	0.173	0.180	0.145	0.99	0.90	0.96
2	0.175	0.175	0.148	0.99	0.90	0.96
3	0.170	0.180	0.146	0.99	0.91	0.95
4	0.180	0.184	0.151	0.99	0.92	0.95
5	0.182	0.177	0.157	1.00	0.92	0.96
6	0.183	0.175	0.165	0.99	0.91	0.95
7	0.187	0.182	0.159	1.00	0.91	0.95
8	0.187	0.188	0.162	1.01	0.93	0.95
9	0.189	0.194	0.180	1.01	0.92	0.96
10	0.192	0.186	0.170	1.02	0.92	0.98
Mean	0.182	0.182	0.158	1.00	0.91	0.96
Std. deviation	0.007	0.006	0.011	0.01	0.010	0.01
Detection Limit	0.021	0.017	0.032	0.03	0.03	0.03

16.7 DETECTION AND REPORTING LIMIT DATA (EPA BLANK METHOD)

The detection limit MDL_b is determined from 10 replicates of blanks. Three runs are performed on three different days. Baseline and sensitivity drift are applied. The detection limit is calculated by multiplying the standard deviation of the blanks by the student factor for 10 replicates ($T = 2.821$) and adding the mean value, if positive.

16.7.1 WATER

Run no.	Low Range			High Range		
	1	2	3	1	2	3
	$\mu\text{mol/L as N}$			$\mu\text{mol/L as N}$		
1	-0.002	0.028	0.032	-0.05	-0.23	0.03
2	0.002	0.035	0.035	-0.06	-0.24	0.02
3	0.000	0.033	0.042	-0.07	-0.25	0.01
4	0.006	0.030	0.034	-0.07	-0.26	0.00
5	0.005	0.024	0.040	-0.07	-0.25	0.01
6	0.010	0.038	0.040	-0.08	-0.26	0.01
7	0.011	0.042	0.043	-0.09	-0.25	0.01
8	0.010	0.037	0.048	-0.09	-0.26	0.01
9	0.013	0.028	0.044	-0.09	-0.26	0.00
10	0.010	0.042	0.031	-0.09	-0.27	0.01
Mean	0.007	0.034	0.039	-0.08	-0.25	0.01
Std. deviation	0.005	0.006	0.006	0.01	0.01	0.01
Detection Limit	0.021	0.051	0.055	0.03	0.03	0.04

16.7.2 SEAWATER

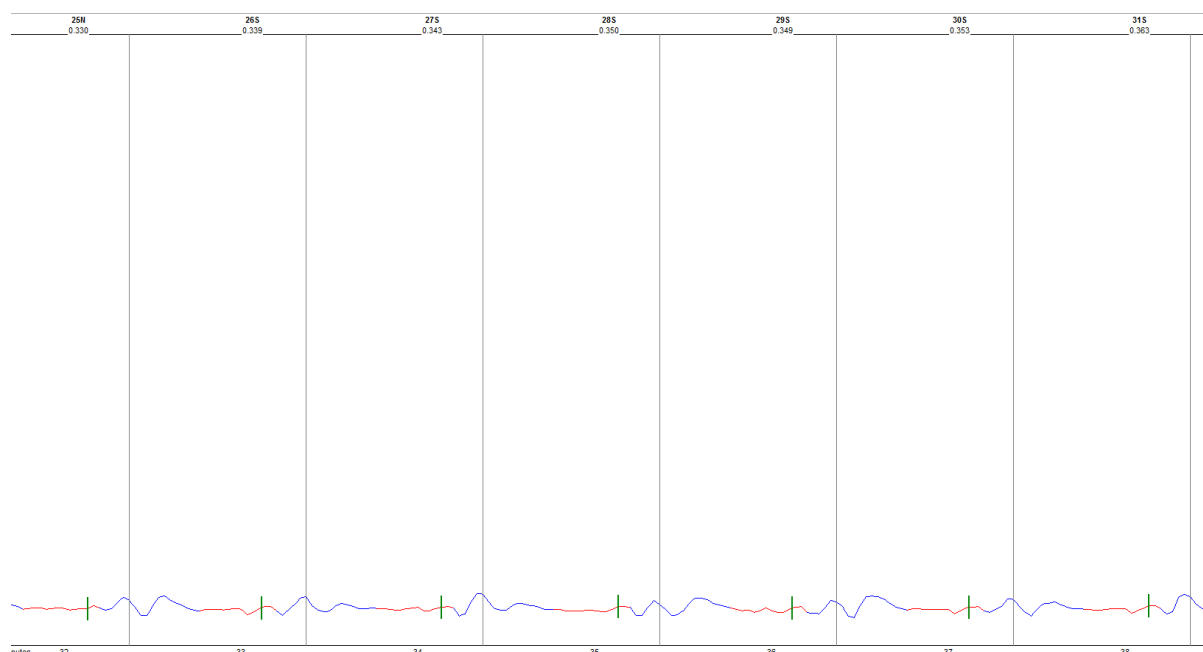
Run no.	Low Range			High Range		
	1	2	3	1	2	3
	$\mu\text{mol/L as N}$			$\mu\text{mol/L as N}$		
1	-0.063	-0.073	-0.093	-0.87	-0.87	-0.80
2	-0.058	-0.070	-0.099	-0.88	-0.87	-0.81
3	-0.062	-0.066	-0.092	-0.88	-0.87	-0.81
4	-0.06	-0.071	-0.099	-0.88	-0.87	-0.82
5	-0.058	-0.057	-0.091	-0.88	-0.87	-0.82
6	-0.058	-0.058	-0.083	-0.88	-0.87	-0.81
7	-0.055	-0.053	-0.081	-0.88	-0.86	-0.82
8	-0.059	-0.051	-0.075	-0.88	-0.86	-0.81
9	-0.052	-0.043	-0.075	-0.88	-0.86	-0.81
10	-0.048	-0.051	-0.085	-0.87	-0.85	-0.80
Mean	-0.057	-0.059	-0.087	-0.88	-0.87	-0.81
Std. deviation	0.005	0.010	0.009	0.004	0.007	0.007
Detection Limit	0.013	0.029	0.025	0.01	0.02	0.02

16.8 OTHER METHOD DATA AND SETTINGS

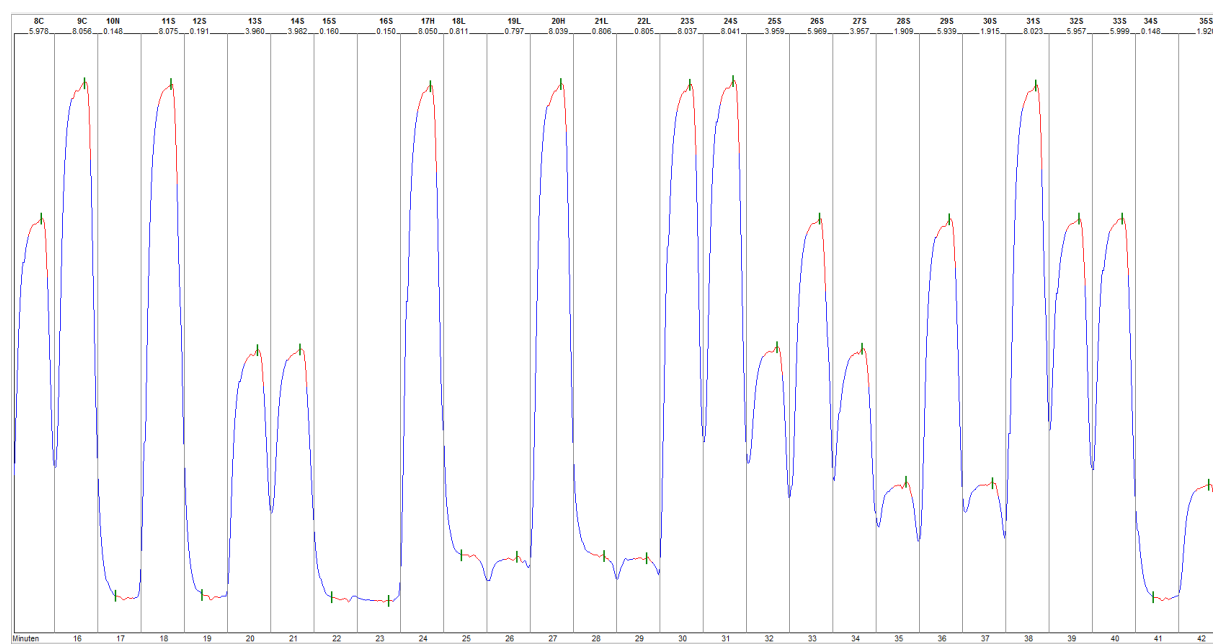
Parameter	Value	Notes
Lag time	12 minutes	Time between sample cup and detector. Depends on number of channels in use.
Carryover	0.3% – 0.8%	See AACE manual for calculation.
Reagent absorbance	0.02 AU	See AACE manual for how reagent absorbance is calculated.
Smoothing	none	See AACE manual for further information.

16.9 TYPICAL PEAK SHAPES

16.9.1 WATER – LOW RANGE

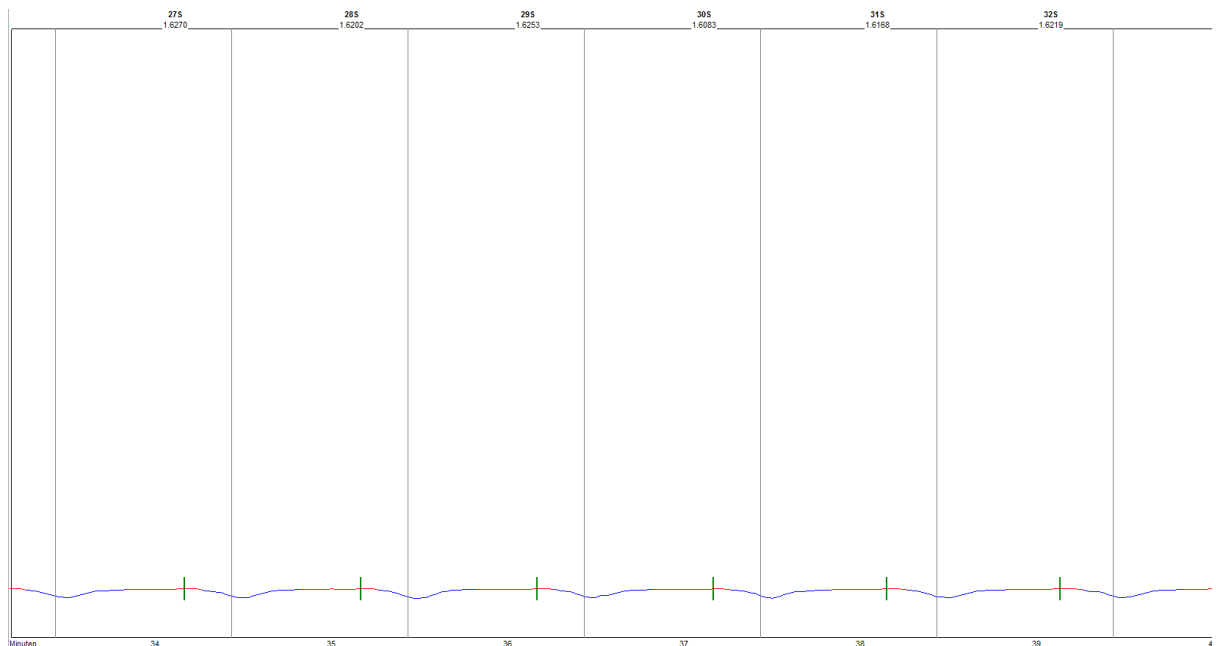


Low range: Spike replicates at 0.16 $\mu\text{mol/L}$ (expanded view)

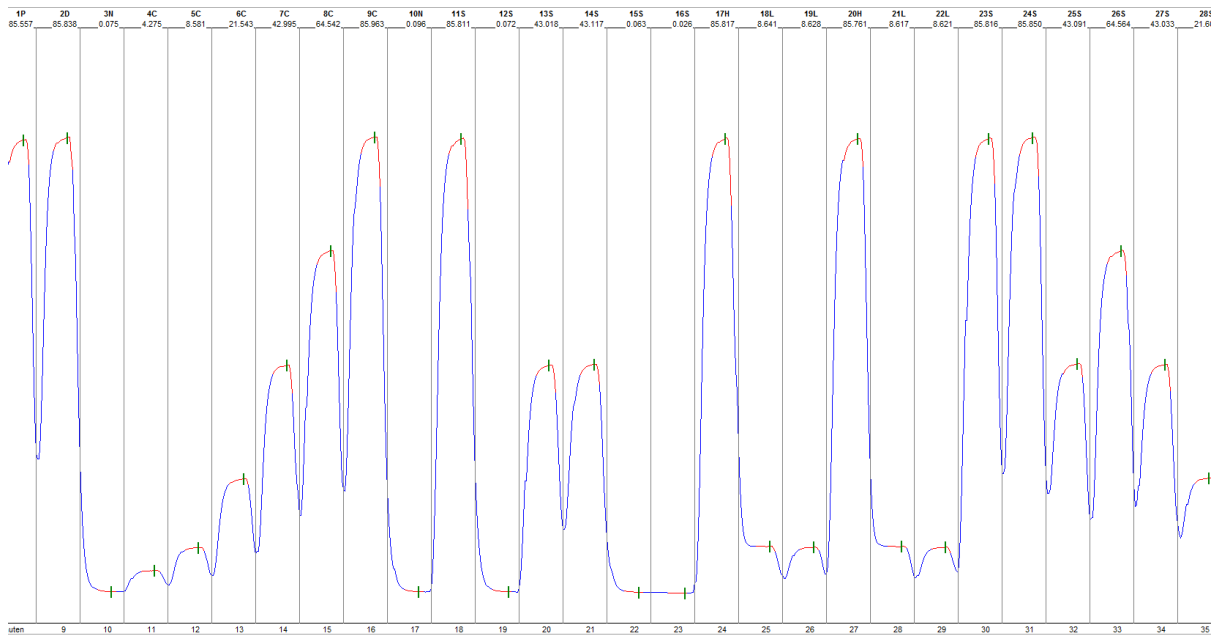


Low range: Excerpt from a test run at 5 concentrations

16.9.2 WATER – HIGH RANGE

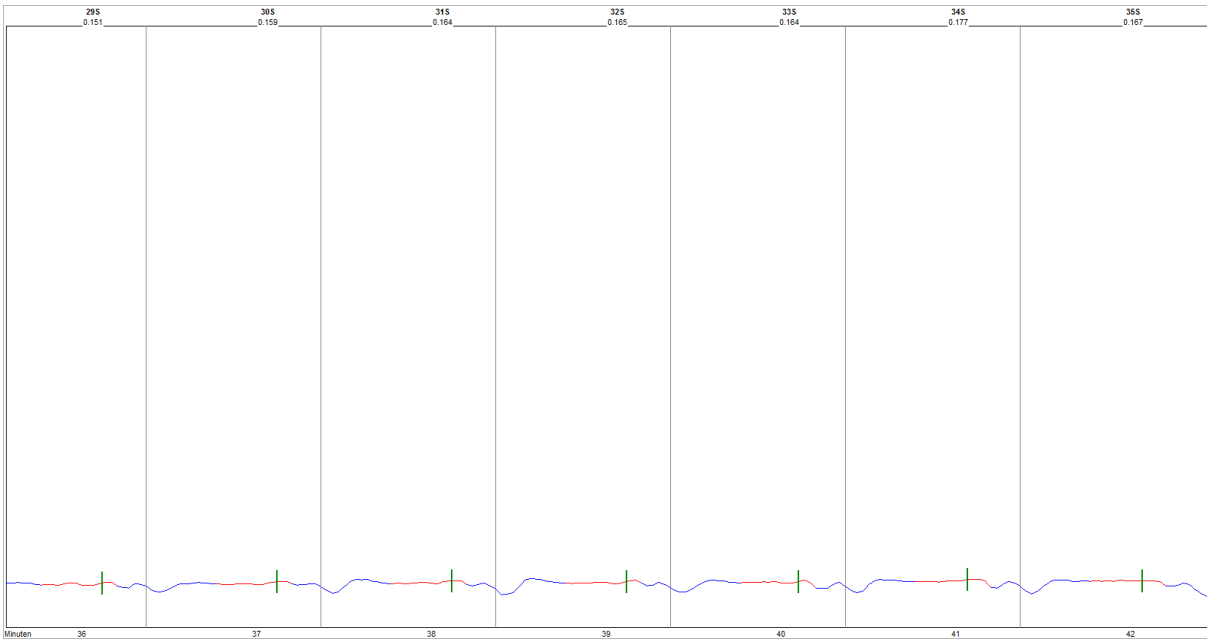


High range: Spike replicates at 1.6 $\mu\text{mol/L}$ (expanded view)

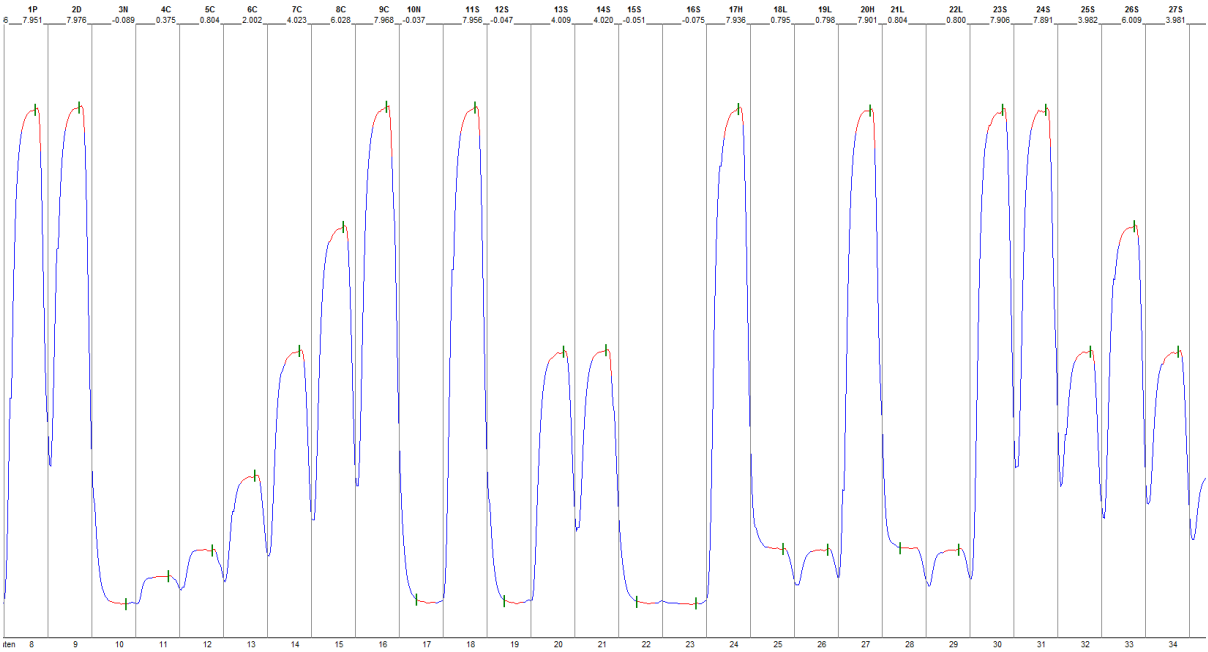


High range: Excerpt from a test run at 5 concentrations

16.9.3 SEAWATER – LOW RANGE

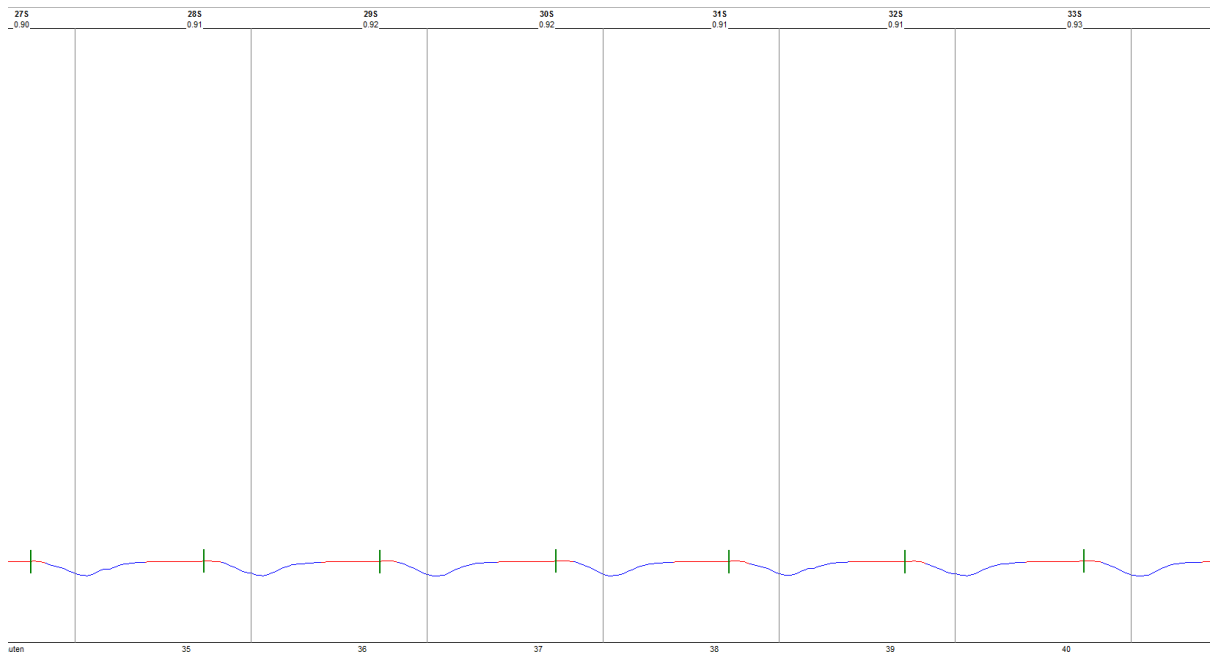


Low range: Spike replicates at 0.16 µmol/L (expanded view)

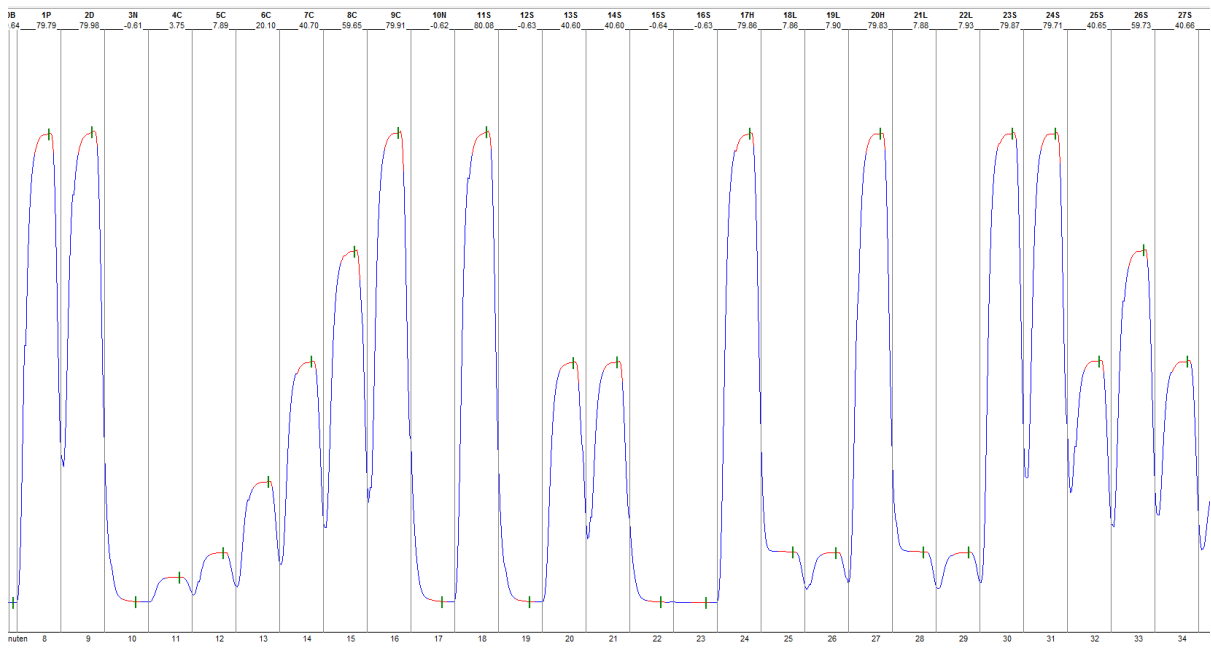


Low range: Excerpt from a test run at 5 concentrations

16.9.4 SEAWATER – HIGH RANGE



High range: Spike replicates at 1.6 $\mu\text{mol/L}$ (expanded view)



High range: Excerpt from a test run at 5 concentrations

17 REVISIONS

Revision	Date	Changes
0	June 2019	New method
1	January 2021	Flowchart and consumables updated
2	August 2021	Air valves tube changed. Consumables list and flowchart updated.

18 PARTS LIST

Only use genuine SEAL parts and consumables with the SEAL logo or the “SEAL Tec” stamp on the package or the part itself. Performance cannot be guaranteed if parts from other sources are used and warranty might be lost if repairs are carried out with non-genuine spare parts or by unauthorized personnel.

18.1 CONSUMABLES KIT – 12 MONTHS

Description	Legend	Part Number	Kit Content
ORN/GRN. 0.10 mL/min		116-0549-04	1 pkg./12
ORN/WHT. 0.23 mL/min		116-0549-06	2 pkg./12
BLK/BLK. 0.32 mL/min		116-0549-07	2 pkg./12
ORN/ORN. 0.42 mL/min		116-0548-08	1 pkg./12
WHT/WHT. 0.60 mL/min		116-0549-09	1 pkg./12
YEL/YEL. 1.20 mL/min		116-0549-12	1 pkg./12
Tubing Norprene	PM07	117+0540-07	2.4 m

18.2 ADDITIONAL TUBINGS

Description	Legend	Part Number	Sales Unit
Tubing PE	PE02	562-2002-01	1 m
Tubing PE	PE15	562-2015-01	1 m
Tubing Tygon	T11	116-0536-11	1 m
Tubing Tygon	T16	116-0536-16	1 m
Reagent tubing small, clear	R01S	116+1101-01	1 m
Reagent tubing small, red	R02S	116+1101-02	1 m
Reagent tubing small, blue	R03S	116+1101-02	1 m

18.3 SPARES KIT

Description	Legend	Part Number	Kit Content
Injection fitting 3 pt.	a	116-0489-01	1 pc
Coil 5 turns + Pt Nipple	5TM+PT	163+G003-05	1 pc
Coil 10 turns	10TM	163+G001-10	1 pc
Coil 10 turns + Pt Nipple	10TM+PT	163+G003-10	1 pc
Connector T	A10	116-B034-01	1 pc
Glass tubing. l = 44 mm	d	116-G004-02	1 pc
Glass fitting. l=51 mm	e	116-G004-03	1 pc
Glass tubing. HB in/out	cl	163+G020-01	1 pc
Glass tubing U	ae	116-0223-48	1 pc
De-rebubbler	cx	163+G035-03	1 pc
Nipple N5	N5	116-0002-01	6 pcs
Nipple N8	N8	116-0003-01	6 pcs
Nipple R13	R13	116+B152-01	6 pcs

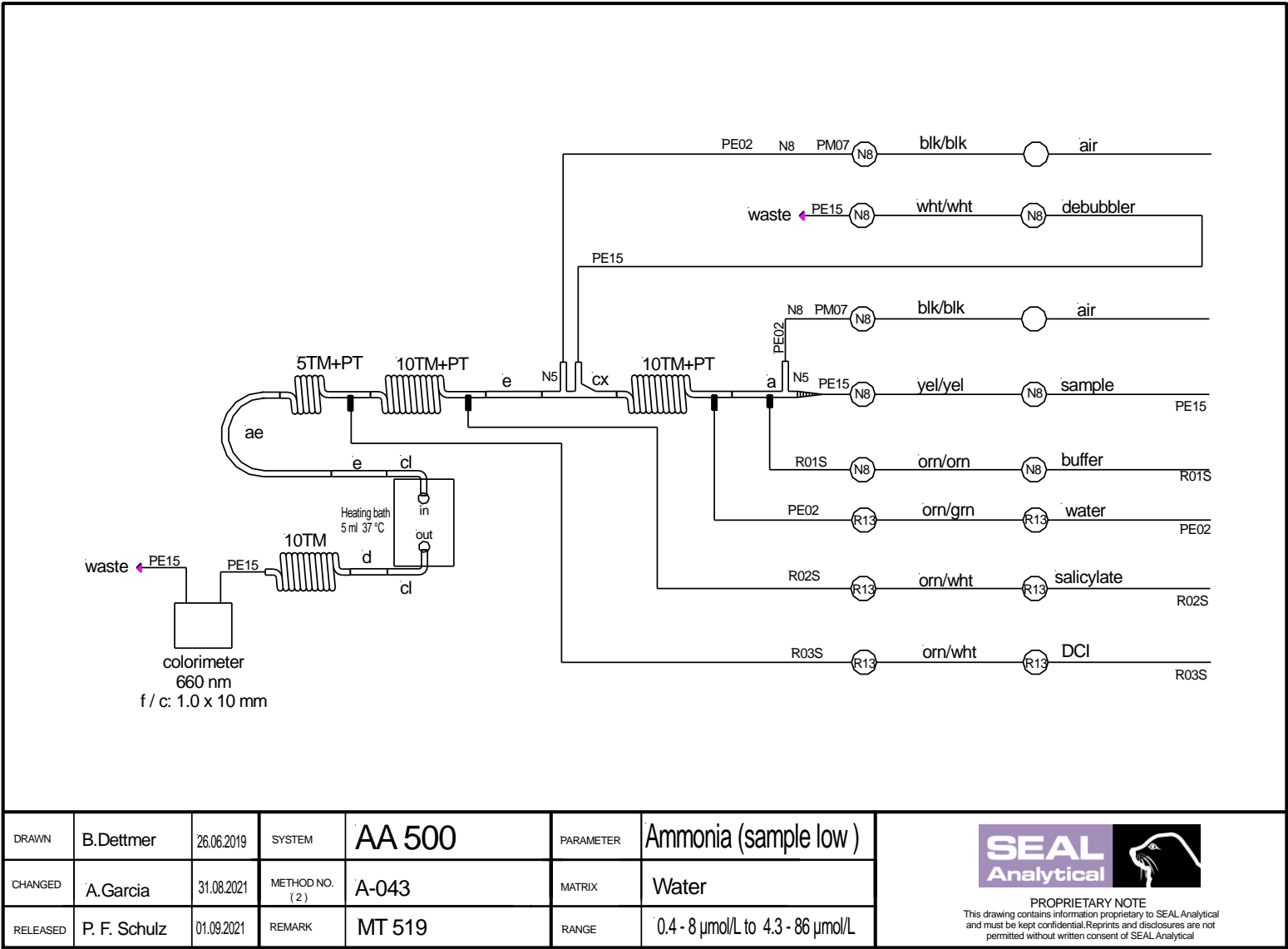
18.4 PHOTOMETER PARTS

Description	Legend	Part Number	Sales Unit
Flowcell 10 mm		169+B045-10	1 pc
Optic Assy 10 mm		161+B650-10	1 pc
Illumination LED. 660 nm		161+B661-66	1 pc
Glass coil 7 turn		161+G500-01	1 pc

18.5 OTHER SPECIAL PARTS

Description	Legend	Part Number	Sales Unit
Coil Assy, 10 turns (5 ml). fix		163+B410-11	1 pc

19 FLOWCHART



DRAWN	B.Dettmer	26.06.2019	SYSTEM	AA 500	PARAMETER	Ammonia (sample low)
CHANGED	A.Garcia	31.08.2021	METHOD NO. (2)	A-043	MATRIX	Water
RELEASED	P. F. Schulz	01.09.2021	REMARK	MT 519	RANGE	0.4 - 8 µmol/L to 4.3 - 86 µmol/L



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